

REMARKS

Applicants note with appreciation the indication of allowable of subject matter by the Examiner, specifically, the subject matter recited in Claims 5 and 23. Now in the application are Claims 1-31 of which Claims 1, 13, 19, and 31 are independent. The following comments address all stated grounds for rejection and place the presently pending claims as identified above, in condition for allowance.

CLAIM REJECTIONS UNDER 35 U.S.C. §103

Claims 1-4, 6-22, and 24-31 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,613,079 of Debique *et al.* (hereinafter “Debique”) in view of U.S. Patent No. 6,658,590 of Sicola, *et al.* (hereinafter “Sicola”). For purposes of clarity in the discussion below, the respective related Claim sets are discussed separately.

IA. Rejection of Claims 1-4 and 6-12 under 35 U.S.C. §103(a):

Claims 1-4 and 6-12 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Debique in view of Sicola. Applicants respectfully traverse this rejection for the following reasons.

Claims 1-4 and 6-12 are directed to a method that is practiced in a storage network. Performance of the method updates a first replica held by a physically remote device in the storage network. The method includes steps of instructing a first data replication facility of a first electronic device in the storage network to log one or more writes to a local storage device when the first replica held by the physically remote storage device cannot be updated due to a detected error condition in the storage network. In accordance with the recited method, the first electronic device further determines if the detected error condition still exists in the storage network that prevents updating of the first replica held by the physically remote storage device. The method further includes a step of instructing the first data replication facility of the first electronic device to replicate data corresponding to the one or more writes identified in the log to generate a second replica upon the determination by the first electronic device that the first replica held by the physically remote storage device can be upgraded due to a removal of the detected error condition. The second replica is outputted from the first electronic device in

accordance with a communication protocol to a second data replication facility of the second electronic device of the physically remote storage device in the storage network to update the first replica. Neither the Debique reference nor the Sicola reference alone or in combination detract from the patentability of Claims 1-4 and 6-12.

The Debique patent teaches a system for verifying the proper operation of a replication facility. The verification system disclosed by the Debique patent operates on a pairwise basis between a first replica and a second replica within the distributed system. An algorithm disclosed by the Debique patent may be applied to each pair of replicas within a replication topology of the distributed system to verify that all possible paths of replication have been tested. Debique assumes such replication topologies have been defined and such topologies may be made known to the disclosed testing tool. In brief, the verification system of the Debique patent verifies that the name space of an object set has been correctly reconciled amongst two replicas (i.e., it verifies that both replicas have the same named objects). In addition, the system verifies that correct propagation of knowledge of changes has occurred amongst replicas in a particular replica set (i.e., it verifies that changes in one replica unknown to the other replica). Before the verification system of the Debique patent is run to verify proper replication, several conditions must be met. See, column 4, lines 23-40 of Debique. Furthermore, in operation, the system of Debique teaches that if it is determined that there is not an object with the same ID in the remote replica, a log maintained at the local replica is examined. In particular, the log is examined to determine if there is a modified object, deleted object or renamed object log entry for the identified object. If a log entry is not found in the local log, the remote log is searched for such log entries. The log entries explain the absence of the object; and thus, no error has occurred. Accordingly, Applicants contend the Debique patent does not teach or suggest a step of instructing a first data replication facility of a first electronic device in a storage network to replicate data corresponding to one or more rites identified in a log to generate a second replica upon determination by the first electronic device the first replica held by the physically remote storage device can be updated due to a removal of the detected error condition that prevents updating of the first replica held by the physically remote storage device, as recited in claim 1.

Sicola teaches the use of remote copy sets. A remote copy set as defined by Sicola is the pairing of volumes between a local storage array and a remote storage array. The pairing of a local volume and a remote volume is referred to throughout Sicola as a "remote copy set".

Sicola defines a remote copy set as consisting of two same sized volumes, one on the local array, and one on the remote array. *See*, column 8, lines 59-61 of Sicola. Sicola further teaches that when all links between local and remote storage sites are down, or when the remote pair of array controllers are inoperative and the remote storage array is inaccessible to the local site then write operations from the local host are directed to both a local storage array and a log unit. *See*, Column 14, lines 12-29 of Sicola.

During the remote outage, Sicola teaches that extents and data from the local site are both written to a log unit associated with the local site. When access to the remote site is restored, the log unit is “replayed” to the remote site. Replaying the log, sends all commands and data to the remote site “partner” in the original transaction order to all remote copy sets associated with the log unit. A merging operation is performed by the system of Sicola to return a remote copy set (both local and remote members) to the same data state after link restoration or remote site restoration. A “mergeback” operation is performed by the system of Sicola to restore the local site back to the same state as the remote site during site fail back. A local log and a remote log are used to replay the transactions for the merge and mergeback functions, respectively. *See*, Column 14, lines 44-59 of Sicola.

Nevertheless, neither Debique nor Sicola, alone or in combination, perform a step of instructing the first data replication facility of the first electronic device to *replicate* data corresponding to the one or more writes identified in the log to *generate a second replica* upon determination by the first electronic device that the first replica held by the physically remote storage device can be updated due to a removal of the detected error condition. More specifically, Debique teaches the use of a log to record an absence of an object and thus no occurrence of an error. Hence, Debique does not teach or suggest such a step. Further, Sicola teaches a replay operation. The replay operation taught by Sicola does not generate a second replica. Rather, the replay operation of Sicola performs a first-in-first-out queuing operation so that the upon re-establishment of communication to the remote site, data in the log is read from and queued in a first-in-first-out manner to return a remote copy site (both local and remote members) to the same data state.

Hence, the Debique patent in view of the Sicola patent, fails to establish a *prima facie* case of obviousness with which to reject Claims 1-4 and 6-12. Neither Debique nor Sicola, alone or in combination, teach or suggest a step of instructing a first data replication facility of the first electronic device to replicate data corresponding to the one or more writes identified in

the log to generate a second replica upon determination by the first electronic device that the first replica held by the physically remote storage device can be updated due to a removal of the detected error condition. Moreover, the Debique patent and the Sicola patent both teach a storage network architecture, function, and operation, distinct from that of the claimed invention. The Debique patent teaches verification of replicas after replication has occurred. Sicola teaches the use of the log as a FIFO buffer. In this manner, when communication to the remote site is restored the buffer or log is emptied in a controlled fashion without the need to replicate data corresponding to one or more writes identified in a log to generate a second replica. Thus, neither the Debique patent nor the Sicola patent, alone or in combination, teach or suggest each and every step of Claims 1-4 and 6-12.

Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the rejection of Claims 1-4 and 6-12 under 35 U.S.C. §103(a).

IB. Rejection of Claims 13-18 under 35 U.S.C. §103(a)

Claims 13-18 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Debique in view of Sicola. Applicants respectfully traverse this rejection for the following reasons.

Claims 13-18 are directed to a method to handle a communication link failure in a computer network. The computer network includes a number of programmable electronic devices, and each of the programmable electronic devices operates as a host device for a data replication facility for replicating data amongst the programmable electronic devices. The method includes a step of instructing each data replication facility of each programmable electronic device to enter a logging routine should the host device of the data replication facility detect the communication link failure. The method further includes a step of instructing each data replication facility of each programmable electronic device that initiated the logging routine to generate a replica for each local write identified in the log upon re-establishment of the communication link.

Neither Debique nor Sicola, alone or in combination teach or suggest a step of instructing *each* data replication facility of *each* of the *plurality of programmable* electronic devices to enter a logging routine should a host device of the data replication facility detect a communication link failure. Debique is concerned with logging to provide an indication to the verification tool that the absence of a replicated object is not an error. Sicola is concerned with logging write operations on a single host when two communication link failures occur. Nowhere does

Debique or Sicola, alone or in combination, teach or suggest instructing *each* data replication facility of *each* of the *plurality of programmable* electronic devices to enter a logging routine upon determination of a link failure. In contrast, the method of Claims 13-18 instruct each data replication facility of each of the plurality of the programmable electronic devices to enter a logging routine should a host device of the data replication facility detect a communication link failure.

Neither the Debique patent nor the Sicola patent, alone or in combination, teach or suggest each and every step of Claims 13-18. Hence, the Debique patent in view of the Sicola patent, fails to establish a *prima facie case* of obviousness with which to reject Claims 13-18.

Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the rejection of Claims 13-18 under 35 U.S.C. §103(a).

IC. Rejection of Claims 19-22 and 24-30 under 35 U.S.C. §103(a)

Claims 19-22 and 24-30 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Debique in view of Sicola. Applicants respectfully traverse this rejection for the following reasons.

Claims 19-22 and 24-30 are directed to a readable medium holding programmable electronic device readable instructions to perform a method in a storage network to update a first replica held by a physically remote storage device in the storage network. The medium includes instructions to instruct a first data replication facility of a first programmable electronic device in the storage network to enter a first state to log one or more writes to a local storage device when the first replica held by the physically remote storage device cannot be updated due to a detected error condition that does not allow transmission of data to the physically remote storage device. The medium further includes instructions to determine at the first programmable electronic device if the first replica held by the physically remote storage device can be updated due to an abatement of the detected error condition. The medium includes instructions to instruct the first data replication facility of the first programmable electronic device to replicate data corresponding to the one or more writes identified in the log in order to create a second replica upon determination by the first programmable electronic device that the first replica held by the physically remote storage device can be updated. Further instructions held by the medium outputs the second replica in accordance with a communication protocol from the first

programmable electronic device to a second data replication facility of a second programmable electronic device in communication with the physically remote storage device in the storage network to update the first replica.

Neither the Debique patent nor the Sicola patent, alone or in combination, teach or suggest each and every element of Claims 19-22 and 24-30. More specifically, neither Debique nor Sicola teach or suggest the generation of a second replica by replicating data corresponding to one or more writes identified in a log. Debique teaches the use of a log to provide an indication to a replication verification tool that the absence of a replicated object is not an error. Sicola is concerned with queuing logged data to replay the logged data in a manner similar to the well know use of “instant reply” used to replay a portion of a sporting event. Replaying the log as taught by Sicola does not mean or equate to replicating data in the log to generate a second replica. Replaying the log as taught by Sicola means or equates to the emptying of a first-in-first-out buffer or queue. In fact, Sicola discloses that even after re-establishment of communications with the remote site the local site continues to write to the log, but the host writes are delayed to allow the merge to catch up to the log writes. More specifically, a “command throttle” routine is executed to slow down host writes so the merge can take place. *See*, Column 15, line 22-24 of Sicola. Sicola teaches the use of the log as a first-in-first-out buffer and does not teach or suggest replication of the data corresponding to writes held by the log.

Neither the Debique patent nor the Sicola patent, alone or in combination, teach or suggest each and every step of Claims 19-22 and 24-30. Hence, the Debique patent in view of the Sicola patent, fails to establish a *prima facie case* of obviousness with which to reject Claims 19-22 and 24-30.

Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the rejection of Claims 19-22 and 24-30 under 35 U.S.C. §103(a).

ID. Rejection of Claim 31 under 35 U.S.C. §103(a)

Claim 31 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Debique in view of Sicola. Applications respectfully traverse this rejection in view of the following arguments.

Claim 31 is directed to a method to update a first replica held by a physically remote storage device in a storage network. Performance of the method in the storage network instructs a first data replication facility of a first electronic device in the storage network to log one or more writes to a local storage device when the first replica held by the physically remote storage device cannot be updated due to a detected error condition in the storage network. The method includes a step of determining at the first electronic device if the detected error condition still exists in the storage network that prevents updating of the first replica held by the physically remote storage device. Performance of the method instructs the first data replication facility of the first electronic device to replicate data corresponding to the one or more writes identified in the log to generate a second replica upon determination by the first electronic device that the first replica held by the physically remote storage device can be updated due to a removal of the detected error condition that prevents updating of the first replica held by the physically remote storage device. By instructing the first replication facility of the first electronic device to halt logging of the one or more writes to the local storage device upon determination that the first replica can be updated, the first electronic device outputs the second replica in accordance with a communication protocol to a second data replication facility of a second electronic device of the physically remote storage device in the storage network to update the first replica. Neither the Debique patent nor the Sicola patent, alone or in combination teach or suggest each and every step of claim 31.

More specifically, neither Debique nor Sicola teach or suggest the generation of a second replica by replicating data corresponding to one or more writes identified in a log. Debique teaches the use of a log to provide an indication to a replication verification tool that the absence of a replicated object is not an error. Sicola is concerned with queuing logged data to replay the logged data in a manner similar to the well know use of “instant reply” used to replay a portion of a sporting event. Replaying the log as taught by Sicola does not mean or equate to replicating data in the log to generate a second replica. Replaying the log as taught by Sicola means or equates to the emptying of a first-in-first-out buffer or queue. In fact, Sicola discloses that even after re-establishment of communications with the remote site the local site continues to write to the log, but the host writes are delayed to allow the merge to catch up to the log writes. More specifically, a “command throttle” routine is executed to slow down host writes so the merge can take place. *See*, Column 15, line 22-24 of Sicola. Sicola teaches the use of the log as a first-in-

first-out buffer and does not teach or suggest replication of the data corresponding to writes held by the log.

Neither the Debique patent nor the Sicola patent, alone or in combination, teach or suggest each and every step of Claim 31. Hence, the Debique patent in view of the Sicola patent, fails to establish a *prima facie case* of obviousness with which to reject Claim 31.

Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the rejection of Claim 31 under 35 U.S.C. §103(a).

CONCLUSION

In view of the remarks set forth above, Applicants contend that Claims 1-31 presently pending in this application, are patentable and in condition for allowance. If the Examiner deems there are any remaining issues, we invite the Examiner to call the undersigned at (617) 227-7400. Applicants believe no fee is due with this statement. However, if a fee is due, please charge our Deposit Account No. 12-0080, under Order No. SMQ-082CN2 from which the undersigned is authorized to draw.

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Respectfully submitted,

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